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(54) Treated papers.

(57) A paper comprising a supporting substrate with a coating including a desizing component and a hydrophilic polymer, and more specifically in an embodiment the paper comprises a supporting substrate treated with desizing agents selected from the group consisting of (1) hydrophilic poly(dialkylsiloxanes); (2) poly(alkylene glycol); (3) poly(propylene oxide) - poly(ethylene oxide) copolymers; (4) fatty ester modified compounds of phosphate, sorbitan, glycerol, poly(ethylene glycol), sulfosuccinic acid, sulfonic acid and alkyl amine; (5) poly(oxyalkylene) modified compounds of sorbitan esters, fatty amines, alkanol amides, castor oil, fatty acids and fatty alcohols; (6) quaternary alkosulfate compounds; (7) fatty imidazolines; and mixtures thereof.

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TREATED PAPERS

This invention relates generally to papers which, for example, are suitable for various printing processes, and more specifically the present invention is directed to size press treated papers suitable for use in ink jet printing processes, dot matrix and impact printers, gravure printing systems, xerographic imaging and thermal transfer printing processes.

Paper is often sized with sizing components for the purpose of retarding or preventing penetration of liquids into the structure. This is commonly done by introducing a material into the pulp during the paper making operation. The acid sizing chemicals, such as Mon size available from Monsanto Chemical Company or alkaline sizing chemicals such as Hercon - 70 available from Hercules Company, are precipitated onto the fibers primarily for the purpose of controlling penetration of liquids into the final dry paper. This process is known as internal sizing. Surface sizing involves the application of dispersions of film-forming substances such as converted starches, gums and modified polymers to previously formed paper. Surface sizing imparts strength to the paper and thus high quality printing papers are often surface sized as well. These internally and surface sized papers, when used to print graphics or interdigitated color patterns with an ink jet printer containing predominantly water based inks, such as for example those inks selected for the Xerox Corporation 4020™ color ink jet printer, yield images which have undesirable pronounced intercolor bleed in most instances (high edge-raggedness). The extent of inter-color bleed is reduced slightly with papers which are internally sized and have no surface sizing. However, in general, these papers usually possess inadequate mechanical strength, and can exhibit enhanced print through. In conventional paper with no surface sizing and with different levels of internal sizing, the intercolor bleed of the ink jet images can be lowered with decreasing sizing, while the print through continues increasing and becomes unacceptable.

In a patentability search report the following United States patents were recited: US-A-4,419,622, which illustrates a method for sizing paper wherein a sizing agent and a sizing accelerator, such as the reaction product of a water soluble polyaminopolyamide, including one derived from the reaction of adipic acid and diethylene triamine, an epihalohydrin, such as epichlorohydrin, diglycidyl ether or polyethylene polyamines is selected; US-A-4,158,... which discloses quaternary ammonium salts of epihalohydrin polymers as flame retarding materials, examples of polymers including water soluble polymers with a predominantly polyalkylamine backbone containing ammonium salt groups; US-A-4,... directed to a sizing composition comprised of a sizing component and an accelerator of a polyaminopolyamide-epichlorohydrin resin. Also note the disclosure of polyamide derived from adipic acid and diethylene triamine at column 11, lines 52 to 64; and US-A-3,... 774 relating to an epihalohydrin polyalkylene amine additive for paper.

There are disclosed in US-A-4,... papers with internal sizing compositions comprising an aqueous mixture of a rosin acid, an ammonium salt, and a resin that is modified with from about 5 to 30 percent based on the weight of the resin of an organic acidic compound selected from the group consisting of an α,β-unsaturated organic acid, an anhydride thereof, and mixtures thereof. In one embodiment, the rosinate and ammonium salt are produced by the reaction product of a base and an acid selected from the group consisting of sulfamic acid, phosphoric acid, acetic acid, methane-sulfonic acid, trichloroacetic acid, nitric acid, sulfuric acid, hydrochloric acid, stearic acid, and acetic acid.

In US-A-4,... there are disclosed anionic sizes for paper or a paper-like material. Substantially equimolecular copolymers of maleic acid anhydride and diisobutylene are esterified to form the corresponding semi-esters. From 40 to 100 mol percent of the anhydride groups are reacted with an aliphatic or cycloaliphatic alcohol, and at least 50 mol percent of the formed carboxylic groups are neutralized with alkali, ammonia or aliphatic amines according to the teachings of this patent in an embodiment thereof.

Further, there is disclosed in US-A-4,...,184 a recording paper with improved image quality, comprising a base paper, the pH of the cold water extract being 5.0 to 10.0, and disposed thereon a coating layer containing a saponified-type petroleum resin sizing agent.

There is disclosure in US-A-4,... a material for writing or printing, which comprises a substrate and a coating layer formed thereon of a material containing a polymer having both hydrophilic segments and hydrophobic segments.

Also, there is illustrated in US-A-4,... cationically charged water soluble vinyl addition polymers and condensation polymers which provide improved emulsification of alkenyl succinic anhydride sizing agents. Sized paper products prepared from alkenyl succinic anhydride emulsions obtained with the polymers disclosed have superior ink holdout according to the teachings of this patent.

Disclosed in the US-A-4,... is a recording medium for ink jet printing comprising a support containing at least in the surface portion thereof a water soluble metal salt with the ion valence of the metal thereof being 2 to 4 and a cationic organic ma-

rials.

Further, there is disclosed in US-A-4,298,[illegible] a paper with sizing agent which contains from 1 to 90 parts by weight of a fixing and sizing accelerating agent and from 0 to 50 parts by weight of conventional sizing agent per 10 parts by weight of hydrophobic, cellulose-reactive sizing materials, the fixing and sizing accelerating agent being a polymer comprised of linear or branched carbon chains to which primary, secondary or tertiary amino and/or quaternary ammonium groups are bound directly or by side chains.

Additionally, there is disclosed in US-A-4,540,[illegible] an internal size composition with a sizing agent comprising, for example, (1) 70 to 99.9 weight percent of a substituted alkyl succinic anhydride or a substituted alkenyl succinic anhydride or a mixture thereof, and (2) 0.1 to 30 weight percent of phosphates of polyoxyethylene alkyl ether esters or phosphates of polyoxyethylene alkyl aryl ether esters and a process of using the composition for the preparation of papers by dispersing the composition, adding the resulting aqueous dispersion to a pulp slurry in paper making materials.

Moreover, there is disclosed in US-A-4,445,[illegible] an ink jet recording sheet comprising a paper support applied on at least one surface thereof or internally a composition which comprises an aqueous dispersion of poly(ethylenevinylidene), vinylpyrrolidone-vinyl acetate copolymer or a mixture thereof serving as a filler or sizing agent and a white filler. The white filler can be contained in a binder weight ratio of 10:1 to 0.2:1 when the composition is applied on the surface of the paper support. When the composition is internally incorporated in the recording sheet, it can comprise 10 to 80 parts by weight of the filler and 2 to 20 parts by weight of the binder per 100 parts by weight of pulp.

Further, there is disclosed in US-A-4,756,[illegible] an ink jet recording sheet with a recording surface which includes a combination of a water soluble polyvalent metal salt and a cationic polymer, said polymer having cationic groups which are available in the recording surface for insolubilizing of an anionic dye.

The following U.S. patents are also mentioned: US-A-4,701,367 relating to coatings such as styrene/butadiene/acrylamide [illegible] for typewriter ribbon transparencies, see the abstract of the Disclosure for example; US-A-4,775,5[illegible] relating to transparent sheet materials for plain paper electrostatic imaging apparatuses, which sheets contain an image receiving layer; US-A-4,7[illegible] relating to transparencies with a coating layer of a certain electrical resistance; and US-A-4,7[illegible] which discloses an ink accepting coating consisting of [illegible] of silica, aluminum silicate, zinc oxide, or titanium dioxide.

There are disclosed in US-A-3,[illegible],244 and US-A-4,2[illegible] methods for the preparation of electrographic recording papers for imaging. More specifically, according to the teachings of these patents electrographic recording papers can be prepared by applying a dielectric coating on a relatively conductive sheet. Various components, such as salts and other components capable of retaining or attracting moisture in the sheet may be incorporated into the paper to enhance the conductive properties. In some recording papers the conductive layer is applied on one side of the paper and the dielectric is applied to the other side. Also, the dielectric layer can be applied over the conductive layer. Other conventional recording papers comprise an electrically conductive layer and a dielectric layer thereon on one surface of a base paper and an electrically conductive layer on the other surface of the base paper. Materials selected as the dielectric layer include highly insulating resins such as silicone resins, epoxy resins, poly(vinyl acetate) resins, vinyl acetate resins, vinyl chloride resins and styrene-butadiene copolymers. These resins are generally dissolved in an organic solvent and coated on the base paper. It is usually necessary to provide an undercoat layer as a barrier coating on a base paper prior to the coating of a solution of an organic solvent type resin to prevent penetration of the solvent used into the paper. Examples of other electrographic papers are prepared by applying a dielectric film of plastic materials such as poly(ethylene) or poly(styrene) to the paper surface by melt extrusion. Also disclosed in US-A-3,011,918; 3,264,137; 3,348,970 and 3,110,621 are papers for electrostatic recording employing aqueous coatings both for the dielectric layer as well as the conductive layer. The materials of the conductive layer can be water soluble or dispersible vinyl benzyl quaternary ammonium compounds and the dielectric layer can be comprised of carboxylated poly(vinyl acetate) in an aqueous ammoniacal solution.

Also disclosed in US-A-3,759,744 is an electrostatic recording paper, which paper can be prepared by applying three successive aqueous coats to a machine glazed side of a paper web. The first coating contains titanium dioxide and an electroconductive water dispersible polymer of a vinyl benzyl quaternary ammonium compound. The second coating can be comprised of oxidized starch and calcium carbonate, and the third coating may contain calcium carbonate and a carboxylated poly(vinyl acetate) in ammoniacal solution. The recording web can then be dried between successive coatings and may be super calendered, see the Abstract of the Disclosure for example.

Additionally, there are disclosed in US-A-3,[illegible],435 and US-A-4,358,[illegible] synthetic papers and methods for the preparation thereof. The term synthetic paper as indicated on page 1, line 20, of US-A-4,358,[illegible] refers to a paper-like textile structure in the form of thin sheets or films of synthetic resinous material, which papers can be employed in writing or

printing processes. Disclosed in US-A-[illegible] are oriented thermoplastic film laminated structures which can be [illegible] for carbon imaging processes. Polymeric film structures having a matte finish and a [illegible] [illegible] achieved with the addition of fillers which roughens the surface upon stretching of the films and renders them receptive to marking by crayons, pencil and ballpoint pen are disclosed in US-A-[illegible]. Laminates comprising layers of oriented films of thermoplastic materials in which at least one of the outermost layers contains a suitable filler addition are disclosed in US-A-[illegible]. These laminates are useful in films which may be written on by a pencil or a crayon.

Disclosed in US-A-[illegible] are synthetic papers with acceptable foldability and comprised of a [illegible] structure of [illegible] resin film or a laminated structure of at least two thermoplastic resin films, see the Abstract of the Disclosure for example. Each of the films is stretched or molecularly oriented, and one or more of the films can contain a fine inorganic filler to provide opaqueness of the film. According to this patent, some of the films may contain certain amounts of poly(styrene) as a foldability improving agent.

Further, in US-A-[illegible], there is illustrated a transparency for ink jet printing comprised of a supporting substrate and thereover a coating of a blend of carboxymethyl cellulose and poly(ethylene oxide). Also, in this patent there is illustrated an ink jet paper wherein the surface coating or sizing is comprised of poly(ethylene oxide).

In US-A-[illegible], there are illustrated ink jet transparencies and ink jet papers with coatings thereover which are compatible with the inks selected for marking, and wherein the coatings enable acceptable optical density images to be obtained. More specifically, in one embodiment of the aforesaid patent there are provided coatings for ink jet paper comprised of a supporting substrate, and thereover a [illegible] mixture of hydroxypropyl cellulose, carboxymethyl cellulose, poly(ethylene oxide), and colloidal silica.

Although the papers disclosed in the prior art are suitable for their intended purposes, there remains a need for papers with new coatings that are useful in ink jet printing processes, electrophotographic imaging and printing processes, including color processes, and that will enable the formation of images with high optical densities. Additionally, there is a need for coated papers that can be selected for ink jet color printing processes. Another need resides in providing papers the fibers of which are coated conformally with certain components as illustrated herein. Further there is a need for papers that avoid or minimize [illegible] of the [illegible], thus [illegible] the life thereof. Also, there is a need for [illegible] papers, or wherein the static charge thereon is [illegible] substantially reduced. Another need resides in the provision of papers for ink jet [illegible], [illegible] and crayon coloring processes, and wherein images of high optical density, such as greater than one, are obtained in some embodiments of the present invention.

It is an object of the present invention to provide papers which meet these needs, and which are suitable for use as ink jet papers or xerographic papers.

According to the invention, there is provided a paper comprising a supporting substrate treated with, or having thereon a coating of, one or more desizing agents selected from (1) hydrophilic poly(dialkylsiloxanes); (2) poly(alkylene glycol); (3) poly(propylene oxide) - poly(ethylene oxide) copolymers; (4) fatty ester modified compounds of phosphate, sorbitan, glycerol, poly(ethylene glycol), sulfosuccinic acid, sulfonic acid, alkyl amine; (5) poly(oxyalkylene) modified compounds of sorbitan esters, fatty amines, alkanol amides, castor oil, fatty acid, fatty alcohol; (6) quaternary dialkylsulfate compounds; (7) fatty imidazolines.

In one embodiment, the present invention relates to papers comprised of a supporting substrate surface treated preferably on a size press, a solvent applicator used to coat or treat the paper during the drying process in a paper machine or a coating apparatus, such as a Film Coater, with a mixture of starch or other similar compound, such as gelatin, with the above-listed desizing agents. The fibers in the surface treated papers may be coated with the aforementioned materials thereby reducing the levels of internal sizing and enabling, for example, these fibers to accept ink compositions with moderate spreading thereof thus preventing or minimizing wicking, a major source of unacceptable print edge raggedness. The desizing components can also be applied to paper sheets on a known coater from aqueous or alcohol solutions. The aforementioned treatment can be modified as indicated herein preferably to optimize the retention of these papers for use in their ink jet printing to improve print through, which modification can be accomplished by the addition of a binder polymer such as hydroxypropylmethyl cellulose, hydroxyethyl cellulose and the like.

The desizing agent may be admixed with a coating binder polymer, or may be dispersed in a resin binder polymer. The binder polymer may be a thermoplastic film forming binder polymer. The desizing agent may be dispersed in or admixed in a film forming binder with filler components, and the filler components may comprise pigments such as [illegible] or [illegible]. The filler may be [illegible] silica or [illegible] oxides.

The desizing agent may be dispersed in, or admixed with, a hydrophilic film forming binder polymer, which polymer contains a mixture of filler components and pigments.

The supporting substrate may be treated on both surfaces thereof with the desizing agents.

Preferred hydrophilic poly(dialkyl siloxanes) are

(a) [illegible] terminated [illegible] siloxanes selected from poly(ethylene oxide)-b-poly(dimethyl siloxane) diblock copolymers and poly(ethylene oxide)-b-poly(dimethyl siloxane)-b-poly(ethylene oxide) triblock copolymers ; (b) poly(dimethyl siloxane)-b-poly(ethylene oxide)-b-poly(propylene oxide) triblock copolymers ; (c) poly(dimethyl siloxane)-b-(poly(alkylene oxide)) diblock copolymers where alkylene is ethylene, propylene or ethylene-propylene ; and (d) poly-[illegible] poly(dimethyl siloxane).

Preferred poly(alkylene glycols) are poly(propylene glycol), poly(ethylene glycol dimethacrylate), poly(ethylene glycol diacrylate), poly(ethylene glycol dimethacrylate), poly(ethylene glycol monomethyl ether), poly(ethylene glycol diglycidyl ether), poly(ethylene glycol dimethyl ether), or poly(1,4-oxybutylene glycol).

Preferred poly(propylene oxide) - poly(ethylene oxide) copolymers are (a) a poly(propylene oxide)-b-poly(ethylene oxide)-b-poly(propylene oxide) triblock copolymer ; (b) a poly(ethylene oxide)-b-poly(propylene oxide)-b-poly(ethylene oxide) triblock copolymer ; or (c) a tetrafunctional block copolymer derived from the sequential addition of ethylene oxide and propylene oxide to ethylene diamine.

Preferred fatty ester modified compounds are (a) mono- or diesters of phosphatides ; (b) sorbitan mono laurate, sorbitan mono oleate and sorbitan trioleate ; (c) glyceryl mono oleate, glyceryl dioleate, glyceryl trioleate ; (d) poly(ethylene glycol) mono oleate, poly(ethylene glycol) mono laurate, poly(ethylene glycol) dioleate, poly(ethylene glycol) distearate, poly(ethylene glycol) di-tallow ; (e) sodium dioctyl sulfosuccinate, ethoxylated alcohol sulfosuccinate, sodium sulfosuccinate ester of lauric diethanolamide, sodium lauryl sulfosuccinate ; (f) dodecylbenzene sodium benzene sulfonate, sodium dodecyl benzene sulfonate ; or (g) coco diethanol amide, lauric diethanol amide, coco monoethanol amide, mono ethanol amide, lauric monoisopropyl amide, or soya diethanol amide.

Preferred poly(oxyalkylene) modified compounds are (a) poly(oxyethylene) sorbitan monolaurate, poly(oxyethylene) sorbitan mono oleate, poly(oxyethylene) sorbitan tri-oleate ; (b) tallow amine ethoxylates, soya amine ethoxylates ; (c) castor oil ethoxylates ; (d) [illegible] ethoxylates ; (e) oleic acid ethoxylates, lauric acid ethoxylates, palmitic acid ethoxylates ; and (f) lauryl alcohol ethoxylates, oleyl alcohol ethoxylates, tallow alcohol ethoxylates, nonyl phenol ethoxylates, octyl phenol ethoxylates, or alcohol ethoxylates.

Preferred quaternary alkosulfate compounds are (a) [illegible] quaternary ammonium ethosulfate ; (b) [illegible] alkyl dimethyl methosulfate ; (c) ethoxylated [illegible] methosulfate [illegible] ; (d) [illegible] methosulfate ; or (e) [illegible] methosulfate.

Preferred poly imidazolines are (a) coco hydroxyethyl imidazoline ; (b) oleic hydroxyethyl imidazoline ; (c) tall oil amino ethyl imidazoline ; or (d) sodium carboxylic coco imidazoline.

Preferred binder polymers are (1) starch ; (2) cationic starch ; (3) gelatin ; (4) hydroxypropylmethyl cellulose ; (5) carboxymethylhydroxyethyl cellulose ; (6) hydroxyethyl cellulose ; (7) sodium carboxymethylhydroxyethyl cellulose ; (8) hydroxypropyl cellulose ; (9) ethylhydroxyethyl cellulose ; (10) methyl cellulose ; (11) poly(acrylamide) ; (12) acrylamide-acrylic acid copolymer ; (13) [illegible] ; (14) poly(vinyl pyrrolidone) ; (15) poly(ethylene imine) [illegible] ; (16) poly(2-acrylamido-2-methyl propane sulfonic acid) ; (17) poly(ethylene oxide) ; (18) cellulose sulfate ; (19) [illegible] copolymers ; (20) hydroxypropyl methyl cellulose ; (21) vinyl methyl ether/maleic acid copolymer ; (22) poly(imidazoline) quaternized ; (23) hydroxyethyl methyl cellulose ; or (24) cationic hydroxyethyl cellulose.

Preferred filler components are clay, calcium silicate, calcium carbonate, hydrated alumina, or colloidal silica, and the pigment components are comprised of calcium silicate, titanium dioxide, barium sulfate, or mixtures thereof.

The desizing agent may be present in an amount of about 0.25 to about 20 percent by weight of the paper, and the ratio of binder polymer to the desizing agent may be from about 1 to about 20. The ratio of filler to binder polymer may be from about 0.1 to about 5.

The supporting substrate may be an internally sized paper with no surface sizing, a surface sized paper with no internal sizing, a surface and internally sized paper, an alkaline sized paper, an acid sized paper, a [illegible] paper, or a [illegible] pigmented paper. The substrate may be of a thickness of from about 50 to about 200 microns and the desizing treatment layer may be of a thickness of 0.5 micron to about 25 microns.

In one form, the invention provides treated papers wherein the fibers thereof are coated with block copolymers thereby enabling, for example, images to be developed thereon which dry in less than ten seconds and have acceptable optical density values, no [illegible] bleeding and excellent [illegible].

The invention also provides treated ink jet papers that permit the substantial elimination of bleeding caused by poor inter-drop coalescence during mixing of the primary colors to generate secondary colors such as, for example, mixtures of cyan and yellow enabling green colors.

In another, the invention provides [illegible] treated sized papers that enable elimination or minimization of bleeding of colors due to intermingling or diffusion of the dye colors when different colors, for example, cyan and yellow, are printed

together with another color like magenta.

The treated ink jet papers enable, for example, water and glycol absorption from the inks selected by a rapid manner thereby permitting such papers to be particularly useful in known ink jet printers.

The coatings of the invention are compatible with fibre papers and sized papers, which coatings will enable the aforementioned materials to generate high optical density images with electrophotographic processes utilizing, for example, liquid toners comprised of a toner resin such as Elvax® dispersed in a solvent such as Isopar, and a charge director.

These and other advantages of the present invention are accomplished by providing treated papers. More specifically, in accordance with one embodiment of the present invention there are provided papers comprised of a supporting substrate treated with a solution of starch and desizing agent, which papers are, for example, compatible with the inks or the toners selected for marking and wherein the papers enable acceptable optical density images to be obtained, especially in ink jet color printing processes. In one embodiment, there are provided papers treated with a mixture of starch and a desizing agent such as block copolymer of poly(dimethyl siloxane)-b-poly(ethylene oxide) wherein the fibers thereof are coated with the block copolymers forming, for example, reducing, avoiding, or controlling the level of internal sizing and rendering the paper more suitable for ink jet printing.

The present invention enables a rapid drying plain ink jet paper with substantially no color through and intercolor bleed values equivalent to a paper with no internal or external sizing. This can be achieved by, for example, treating sized papers with desizing agents which penetrate into the paper, lift the sizing from the fibers and rearrange the sizing material in the bulk of the paper which results in overcoming print through problems. The desizing agents can be applied on a known coater to substantially any commercially available paper and thereby converting it to an ink jet paper. This treatment can also be effected to an internally sized paper at the size press by incorporating the desizing agent into starch or any other similar binder material.

Embodiments of the present invention include a paper comprised of a fibrous supporting substrate such as a Xerox paper treated with desizing agents, that is a polymeric or nonpolymeric material which will remove the sizing compositions deposited on the fibers of cellulose during the paper making process thereby reducing the sizing present in paper, which desizing agents are comprised of (1) hydrophilic poly(dimethyl siloxanes) such as water soluble carbinol terminated polydimethyl siloxane with weight average molecular weight of, for example, from about 1,000 to about 5,000, water soluble poly(dimethyl siloxane) ethoxylates or poly (dimethyl siloxanes) with a dimethyl siloxane content of from about 15 to 50 percent by weight with weight average molecular weight of, for example, from about 1,000 to 100,000; (2) poly(dimethyl siloxane)-b-poly(alkylene oxide) and [illegible] water soluble block copolymers with a weight average molecular weight of, for example, from about 1,000 to about 5,000 and dimethyl siloxane content of from about 15 to about 50 percent by weight, where alkylene contains from 1 to about 20 carbon atoms such as ethylene, propylene and ethylene propylene; (3) methanol and water soluble poly(propylene oxide)-poly(ethylene oxide) block copolymers with a propylene oxide content of about 75 to about 90 percent and a weight average molecular weight of from about 500 to 100,000; (4) alcohol soluble, such as methanol or ethanol, and the like, poly(propylene glycol) with a weight average molecular weight of between about 400 to about 5,000, and alcohol soluble poly(propylene glycol dimethacrylates) with weight average molecular weight of between about 400 to about 5,000; (5) alcohol soluble fatty esters of phosphate, glycerol, sorbitan, mono and dibasic acids, sulfonic acid, and sulfosuccinate acid; (6) alcohol soluble alkanolamides, alkanolamine ethoxylates and amine ethoxylates; (7) water soluble propoxylated quaternary ammonium ethosulfates; (8) fatty imidazoline quaternized water and alcohol soluble and nonquaternized alcohol soluble fatty imidazolines; and (9) alcohol and water soluble fatty alcohol modified poly(oxyalkylenes) and mixtures thereof, which desizing agents can be dispersed in a resin binder or mixtures of binders and a filler or fillers. When these desizing agents are applied to paper, they are generally present in effective amounts of from about 1 to about 20 percent by weight in water or alcohol, and preferably from about 1 to about 10 percent by weight in water. Primarily because of their low cost and nontoxic properties, desizing agents which are soluble in water are preferred.

In another embodiment of the present invention there is provided a paper comprised of a supporting substrate treated with desizing agents selected from the group consisting of (1) hydrophilic poly(dimethyl siloxanes), (2) poly(alkylene glycol), the derivatives thereof, (3) poly(propylene oxide) - poly(ethylene oxide) copolymers, (4) fatty ester modified compounds of phosphate, sorbitan, glycerol, poly(ethylene glycol), sulfosuccinic acid, sulfonic acid, or alkyl amine; (5) poly(oxyalkylene) modified compounds of sorbitan esters, fatty amines, alkanol amides, castor oil, fatty acid, or fatty alcohol; (6) quaternary alkosulfate compounds; and (7) fatty imidazolines and mixtures thereof; a paper comprised of a supporting substrate with a coating comprised of a desizing component dispersed or admixed with a binder resinous polymer, or the desizing

toner papers wherein the desizing agent is present in a resin, preferably hydrophilic, polymer binder.

The binder polymers when used in combination with the desizing agents are, for example, selected from the group consisting of (1) starch; (2) cationic starch; (3) gelatin; (4) hydroxyalkylmethyl cellulose where alkyl is from 1 to about 25 carbon atoms such as methyl, ethyl, propyl, butyl, pentyl, hexyl, heptyl, octyl, and the like; (5) sodium carboxymethyl cellulose; (6) sodium carboxymethylhydroxyethyl cellulose; (7) hydroxyethyl cellulose; (8) hydroxypropyl cellulose; (9) alkylhydroxyethyl cellulose where alkyl is from 1 to about 25 carbon atoms such as methyl, ethyl, propyl, butyl, and the like; (10) methyl cellulose; (11) cellulose acetate; (12) an acrylamide-acrylic acid copolymer; (13) poly(vinyl alcohol); (14) poly(vinyl pyrrolidone); (15) poly(ethylene imine) epichlorohydrin; (16) poly(2-acrylamido-2-methyl propane sulfonic acid); (17) poly(ethylene oxide); (18) cellulose sulfate; (19) quaternary ammonium copolymers; (20) hydroxypropylmethyl cellulose; (21) vinyl methyl ether/maleic acid copolymer; (22) poly(vinylamine) quaternized; (23) hydroxypropyl methyl cellulose; (24) cationic cellulose; (25) blends or mixtures thereof with starches and celluloses being particularly preferred primarily because of their availability and applicability to paper; and the like. Mixtures of blends include the binder components in effective amounts as indicated herein, including, for example, from about 5 to about 95 weight percent of one material, and about 95 to about 5 weight percent of a second material. Generally, the ratio of binder to desizing agent depends on the capacity of the desizing agent to desize paper but commonly this ratio varies from about 1 to about 10 in size press and from about 1 to about 20 in coating applications. Also, more than two components can also be selected, thus, for example, up to five components may be included in the blends providing some of the objectives of the present invention are achievable with each of the components being present in an effective amount whereby the total amount of all components is equal to about 100 percent.

The ink or toner receiving surface where the developed image is contained in an embodiment of the present invention may include brightener filler components in various effective amounts such as, for example, from about 1 to about 50 percent by weight. Examples of fillers include colloidal silicas (available, for example, as Syloid 74 from Grace Company; preferably present, for example, in one embodiment in an amount of 20 weight percent; titanium dioxide (available as Rutile or Anatase from NL Chem Canada Inc.); hydrated alumina (Hydrad TMC-HBF, Hydrad TM-HBC, J.M. Huber Corporation); barium sulfate (K.C. Blanc Fix HD80, available from Kali Chemie Corporation; and calcium carbonate (Microwhite Sylacauga Calcium Products); high brightness clays (Engelhard Paper Clays); latex plastic pigments (TPX-788 Dow Chemicals); calcium silicate (J.M. Huber Corporation); insoluble cellulose melamine (Scientific Polymer Products); and the like. The primary purpose of the brightener filler is to enhance color mixing and assist in improving show-through in an embodiment of the present invention.

In an embodiment of the present invention, the substrate is comprised of clean blends of hardwood kraft and softwood kraft fibers which blends contain from about 10 percent to 90 percent by weight of soft wood and from about 90 to about 10 percent by weight of hardwood. Examples of hardwood include Seagull W dry bleached hardwood kraft preferably present, for example, in one embodiment in an amount of 70 percent by weight. Examples of softwood include La Tuque dry bleached softwood kraft present, for example, in one embodiment in an amount of 30 percent by weight. These sized substrates may also contain fillers and pigments in effective amounts of from about 1 to about 60 percent by weight such as clay (available from Georgia Kaolin Company, Astro-fil 90 clay, Engelhard Ansilex clay), titanium dioxide (available from Tioxide Company - Anatase grade AHR), calcium silicate CH-427-97-8, XP-974 (J.M. Huber Corporation), and the like. Also, the sized substrates may contain various effective amounts of sizing chemicals (for example from about 0.25 percent to about 25 percent by weight of pulp) such as Mon size (available from Monsanto Company), Hercon-76 (available from Hercules Company), Alum (available from Allied Chemicals as Iron free alum), retention aid (available from Allied Colloids as Percol 292). The sizing values of papers, including the commercial papers that can be selected for the present invention in an embodiment thereof, vary between about 0.4 second to about 4,685 seconds. However, papers in the sizing range of 50 seconds to 300 seconds are preferred, primarily to decrease costs. The porosity values of the substrates which are preferably porous varies from about 100 to about 1,260 ml/minute and preferably from about 100 to about 600 ml/minute to permit, for example, the use of these papers for various printing technologies such as thermal transfer, liquid toner development, xerography, ink jet processes, and the like.

Illustrative examples of commercially available, internally and externally (surface) sized substrates that may be selected for the present invention, and are treated with a desizing agent dispersed in an optional binder with a thickness of, for example, from about 50 µm to about 250 µm and preferably of a thickness of from about 100 µm to about 125 µm or thereabout may be selected for the aforementioned papers include Diazo papers, offset papers such as Great Lakes offset, recycled papers such as Conservation, office papers such as Ball-Answer, Edey liquid toner paper and copy papers from companies such as Nekoosa, Champion,

[illegible] Nonwoven, Glass, Powder, [illegible] with Kenes [illegible] papers and [illegible] [illegible] being particularly preferred in view of their [illegible], and low [illegible] through.

Specific examples of thickening agents that can be selected for the treatment or coating on a single side, or both sides thereof of papers include: (1) [illegible] polydimethyl siloxanes such as (a) Poly(dimethyl siloxane) [illegible] (PDSM, Polymer Systems Inc.) and [illegible] terminated (PDSM, [illegible], Polymer Systems Inc.), (b) polydimethyl siloxane-b-polydimethyl siloxane, alkylene oxide) copolymers (PS 073, PS 072, PS 071, Petrarch Systems Inc.), Alkasil HEP 182-280, Alkasil HEP 148-330, Alkaril Chemicals, [illegible] copolymers containing 8-12 linkages; (c) [illegible] [illegible] polypropylene [illegible] copolymers (Alkasil NEP 73-70, Alkaril Chemicals), [illegible] containing 31-33% [illegible]. (II) poly [illegible] poly(dimethyl siloxane) copolymers which can be obtained by the addition reaction of a [illegible] polysiloxane with [illegible] containing olefinic bonds, and then reacting the product with a diamine; (2) polyethylene glycol, and its derivatives (a) polypropylene glycol (Alkapol PPG-425, Alkapol PPG-4000, Alkaril Chemicals); (b) poly(propylene glycol dimethacrylate), poly(ethylene glycol diacrylate), poly(ethylene glycol di methacrylate), poly(ethylene glycol monomethyl ether), poly(ethylene glycol dimethyl ether), poly(ethylene glycol diglycidyl ether) (all from Polysciences), (c) poly(1,4-oxybutylene) glycol) (Scientific Polymer Products); (3) copolymers of [illegible] polypropylene oxide with hydrophilic polyethylene oxide, (a) [illegible] soluble - Tetronic 150R1, Pluronic L-101, Tetronic 902, Tetronic 25R2 (BASF Corporation), Alkatronic EGE-1 (Alkaril Chemicals); (b) water soluble - Tetronic 908, 50R8, 25R8, 904, 90R4, Pluronic F-77 all from BASF Corporation, and Alkatronic EGE-25-2 and PGP 33-8 from Alkaril Chemicals. (4) [illegible] modifications of (a) phosphates (Alkaphos [illegible], Alkaril Chemicals); (b) sodium (Alkamuls STO [illegible]), Alkamide SDL [illegible], Alkamide [illegible] Alkaril Chemicals), (c) glycerate (Alkamuls GMO - 45LG [illegible]), Alkamuls GDO [illegible], Alkamuls GTO [illegible]; (d) polyethylene glycol (Alkamuls 600 DO [illegible]), Alkamuls 400-MO [illegible], Alkamide [illegible], Alkamuls [illegible], Alkaril Chemicals); (e) sulfosuccinic acid (Alkasurf SS-O-75 [illegible]), Alkasurf SS-DA4-HE [illegible] alcohol sulfosuccinate), Alkasurf SS-L7DE [illegible] sulfosuccinate [illegible]), Alkasurf SS-L-HE [illegible] sulfosuccinate), Alkaril Chemicals), (f) sulfonic acid (Alkasurf CA, [illegible]

[illegible] sulfonate), Alkasurf [illegible], [illegible] sulfonate), Alkaril Chemicals), (g) alkyl amines (Alkamide SDO [illegible] amine), Alkamide CDE [illegible] amide), Alkamide DME [illegible] amide), Alkamide L9DE [illegible], Alkamide L7DE [illegible] amide), Alkamide L203 [illegible], Alkaril Chemicals); (5) polyoxyalkylene derivatives of (a) sorbitan esters (Alkamuls PSML-4 [illegible] sorbitan [illegible]), Alkamuls PSMO-20 (polyoxyethylene sorbitan monooleate), Alkamuls PSTO-20 (polyoxyethylene sorbitan trioleate), Alkaril Chemicals; (b) fatty amines (Alkaminox T-2, T-5 tallow amine ethoxylates), Alkaminox SO-5 (soya amine ethoxylate), Alkaril Chemicals), (Icomeen 1-2, Icomeen T-15, ICI Chemicals); (c) castor oil (Alkasurf CO-40 [illegible] ethoxylates), Alkaril Chemicals), (d) alkanol amide (Alkamidox C-2, C-5 [illegible] ethoxylates), Alkaril Chemicals); (e) fatty acid (Alkasurf O-14 [illegible]), Alkasurf O-10 (oleic acid ethoxylates), Alkasurf L-14 (lauric acid ethoxylate), Alkasurf P-7 (palmitic acid ethoxylate)); (f) fatty alcohol (Alkasurf LAN-1, LAN-3, Alkasurf TDA-8, Alkasurf SA-2, [illegible] ethoxylates), Alkasurf NP-1, NP-11 (nonyl phenol ethoxylates), Alkasurf OP-1, OP-12 (octyl phenol ethoxylates), Alkasurf LAEP-15, Alkasurf LAEP-25, Alkasurf LAEP-65 (linear alcohol ethoxylates)); (6) quaternary compounds (a) [illegible] quaternary [illegible] [illegible] (Emcol CC, Gardex AT-172, [illegible] Corporation); (b) quaternary dialkyl dimethyl methosulfate (Alkaquat DHTS (hydrogenated tallow)); (c) alkoxylated [illegible] methosulfate quaternary (Alkasurf DAET [illegible] derivative)); (d) fatty imidazoline methosulfate quaternary (Alkaquat T (tallow derivative), Alkaril Chemicals); (7) fatty imidazolines and their derivatives (a) Alkazine - O (oleic derivative), (b) Alkazine-TO (tall oil derivative), (c) Alkazine [illegible] [illegible] [illegible] imidazoline [illegible]), Alkaril Chemicals); (d) Arquad-S, (e) Arquad-2.5, [illegible] Chemicals; and the like.

Specific examples of binder polymers which [illegible] the coating agent can be dispersed is selected, preferably hydrophilic film forming compounds, include (1) starch (Starch [illegible], St. Lawrence Starch); (2) cationic starch (Cato-72, National Starch); (3) gelatin (calfskin gelatin, Polymer Sciences); (4) hydroxypropylmethyl cellulose (Methocel K35LV, available from Dow Chemical Company), (5) sodium carboxymethyl cellulose (CMC Type 7HOF, 7HSOF, Hercules Chemical Company); (6) hydroxyethyl cellulose (Natrosol 250LR, Hercules Chemical Company); (7) sodium carboxymethylhydroxyethyl cellulose (CMHEC 43H, 37L, Hercules Chemical Company); CMHEC 43H is a high molecular weight polymer with carboxymethylcellulose (CMC)/hydroxyethyl cellulose (HEC) ratio of 4:3. CMHEC 37L is a low molecular weight polymer with CMC/HEC ratio of

papers of the present invention can be any one in a device in which two or more ink jet printheads (or other printing elements) and which different components are selected, for example, or other processes are utilized.

In other specific process embodiments, the papers of the present invention are prepared by providing a substrate such as Xerox 4024™ acidic sheet, porous paper of 108 μm in thickness and applying on both sides a mixture of calcium silicate, 60 percent by weight, poly(ethylene oxide)-b-poly(dimethyl siloxane)-b-poly(ethylene oxide) triblock copolymer, 2 percent by weight, poly(bis-ethylene) quaternized, 4 percent by weight, from a 5 percent by weight solution in water on a size press. The thickness of the treatment blend after drying the paper at 100°C was measured at 2 μm. These papers were fed in a Xerox 1075™ imaging apparatus and images with optical density values of 1.3 black were obtained with a print through value of 0.025. These electroconductive papers were then printed with a Xerox 4020™ ink jet printer and images with optical density values of 1.01 (black), 1.02 (magenta), 0.87 (cyan), 0.86 (yellow) were obtained which had a print through value of 0.105. These images could not be handwiped or lifted off with a 3M scotch tape 60 seconds subsequent to their preparation.

In another process embodiment, the papers of the present invention are prepared by providing a porous acidic substrate filled with calcium silicate and clay, in a thickness of 125 μm, and applying to both sides on a size press, in a thickness of 0.3 μm, a desizing agent such as Cartax AL-172, which was present in a concentration of 2 percent by weight in water. Thereafter the paper can be air dried at 100°C and the resulting paper is fed separately into a Xerox 4020™ color ink jet printer to obtain images of high optical density, no edge raggedness and a print through value of 0.068.

In the known formation and development of xerographic images, there is generally applied to a latent image generated on a photoconductive member a toner composition (dry or liquid) of resin particles and pigment particles. Thereafter, the image can be transferred to a suitable substrate such as the papers herein, the treated papers of the present invention, or plain paper and affixed thereto by, for example, heat, pressure or combination thereof.

The imaging technique in ink jet printing involves the use of one or more ink jet assemblies connected to a pressurized source of ink, which is comprised of water, glycols, and a colorant such as magenta, cyan, yellow or black dyes. Each individual ink jet includes a very small orifice usually of a diameter of 60 μm, which is energized by magneto restrictive piezoelectric means for the purpose of emitting a continuous stream of uniform droplets of ink at a rate of 33 to 75 kilohertz. This stream of droplets is desirably directed onto the surface of a moving web of, for example, the treated paper of the present invention, which stream is controlled to permit the formation of printed characters in response to video signals derived from an electronic character generator and in response to an electrostatic deflection system.

In thermal transfer printing, the printer such as an Okimate 20 is equipped with a data input-interface peripheral, a three color, such as magenta, cyan and yellow, transfer ribbon, a mechanism to synchronize the combination of head, paper and ribbon motion, and a properly specified ribbon material. The data from the input interface is fed to the thermal head which makes contact with the back of the ribbon substrate and melts the inks. The melted inks are then transferred to the treated papers of the present invention.

In dot matrix printing, the printer such as a Roland PR-1012 is connected to an IBM-PC computer loaded with a screen dump software specially supplied by the printer. Any graphic images produced by the appropriate software on the screen can be printed by using the print screen key on the computer keyboard. The ink ribbons used in dot matrix printers are generally comprised of Mylar coated with blends of carbon black with nylon, blue pigment dispersed in an oil, such as rape seed oil, and a surfactant, such as lecithin. Other commercial ribbons, which are also used in typewriter printing, can be selected and are usually comprised of Mylar coated with blends of acrylic nylon, carbon black and mineral oil.

The drying time of images obtained with the treated papers of the present application is the time for zero image-offset and can be measured as follows. A line comprised of different color sequences is drawn on the ink jet paper using the Graphics of Inks Bath, the inkjet heads moving from left to right and back. Thereafter, this image is purposely smeared with the pinch roll of the printer by fast forwarding the paper mechanically while the pinch roll is at the top of the imaged line. This whole procedure takes about two seconds to accomplish. In the event there is no offset of the printed image on the unprinted paper, the drying time of the image is considered as less than two seconds.

The Hercules size values recited herein were measured on the Hercules sizing tester (Hercules Incorporated) as described in TAPPI STANDARD T-530 pm-83 issued by the Technical Association of the Pulp and Paper Industry. This method is closely related to the widely used ink flotation test. The TAPPI method has the advantage over the ink flotation test of detecting the end point photometrically. The TAPPI method employs a mildly acidic aqueous dye solution as the penetrating component to permit optical detection of the liquid front as it moves through the paper sheet. The apparatus determines the time required for the reflectance of the sheet surface not in contact with the penetrant to drop to a predetermined (80 percent)

[illegible]; (9) hydroxypropyl cellulose (Klucel Type E, Hercules); (10) water soluble ethylhydroxyethyl cellulose (Bermocoll, Berol Nobel AB, Sweden); (11) methyl cellulose (Methocel A4M, Dow Chemical Company); (12) poly(acrylamide) (Scientific Polymer Products); (13) acrylamide-acrylic acid copolymer (Scientific Polymer Products); (14) poly(vinyl alcohol) (Elvanol, DuPont Company); (15) poly(vinyl pyrrolidone) (GAF Corporation); (16) poly(ethylene imine) epichlorohydrin (Scientific Polymer Products); (17) poly(2-acrylamido-2-methyl propane sulfonic acid) (Scientific Polymer Products); (18) poly(ethylene oxide) (Poly Ox WSRN-3000, Union Carbide); (19) cellulose sulfate (Scientific Polymer Products); (20) montmorillonite, [illegible] (Mineral WT, Mineral AS-1, Mineral AS-2, Mineral A-10, Mineral B, Morgan 100, Morgan 550, [illegible] Incorporated); (21) hydroxy butylmethyl cellulose (HBMC, Dow Chemical Company); (22) vinyl methyl ether/maleic acid copolymer (Gantrez S-95, GAF Corporation); (23) poly(diallyldimethyl ammonium chloride) (Scientific Polymer Products); (24) hydroxyethylmethyl cellulose (HEM, British Celanese Ltd., Tylose MH, MHK, Kalle A.G.); (25) carboxymethylhydroxyethyl cellulose (Polymer JR-125, Poly [illegible], Amerchol, [illegible], Celcoloza, Union Carbide) and mixtures thereof, which mixtures include, for example, various effective amounts of from 1 to about 5 components in any embodiment of the present invention with the amount of components totaling 100 percent. Thus, for example, a first component can be present in an amount of from about 5 to about 95 weight percent and a second component can be present in an amount of from about 95 to about 5 weight percent.

The ink receiving surfaces can contain coating compositions in various thicknesses as indicated herein depending, for example, upon the coatings selected and the components utilized; however, generally the total thickness of the treatment layer is from about 0.1 μm to about 25 μm and preferably from about 0.5 μm to 10 μm. The coating of, for example, desizing agent in water can be applied to paper by a number of known techniques including size press treatment, dip coating, reverse roll coating, extrusion coating, and the like. The surface treatment of the papers can, for example, be accomplished on a KRK size press by dip coating and by solvent extrusion on a Faustel Coater. The KRK size press is a lab size press that simulates a commercial size press. This size press is normally sheet fed as contrasted to a commercial size press wherein a continuous web is selected. On the KRK size press in one embodiment, the sheet of paper is taped by one end to the carrier mechanism plate. The speed of the test and the roll pressures are set, and the coating solution is poured into the solution tank. A 4 liter stainless steel beaker, for example, is situated underneath for retaining the solution overflow. The sheet of paper is cycled once through the system (without moving the paper sheet) to wet the surface of the rolls and then returned to the feed area where it is cycled the second time. While the rolls are being "wetted", the sheet is fed through the nip rolls by pressing the carrier mechanism start button. The sheet paper is then removed from the carrier mechanism plate and is placed on a 30 by 40 cm sheet of 750 μm thick Teflon for support and is dried on the Dynamic Former drying drum and is held under restraint to prevent shrinkage. The drying temperature is approximately 105°C. This method of dicing treats both sides of the paper simultaneously.

In dip coating, a web of the material to be coated is transported below the surface of the coating, for example, desizing agent in binder material by a single roll in such a manner that the exposed site is saturated, followed by the removal of any excess coating by the squeeze rolls and drying at 100°C in an air dryer.

The method of surface treating paper using a solvent results in a continuous sheet of paper with the coating material applied first to one side and then to the reverse side of the paper selected. With a known slot extrusion process, there is selected a flat die with the die lips in close proximity to the web of paper to be treated, resulting in a continuous film of the solution evenly distributed across the sheet, and thereafter dried in an air dryer at 100°C.

In one specific process embodiment, the papers of the present invention can be prepared by providing a porous, internally sized sheet, substrate such as Xerox 4024 (in roll form) in a thickness of from about 100 to about 125 μm and applying to both sides of the paper by the known dip coating process on a Faustel coater, in a thickness of 0.1 to 5 μm, a desizing agent such as Cartax AI-172, which agent is present in a concentration of 2 percent by weight in water. Thereafter, the paper with the coating is air dried at 100°C, and the resulting paper can be utilized in an ink jet printer, and the like as indicated herein.

In another specific process embodiment, the papers of the present invention are prepared by providing a substrate such as Xerox 4024™ (internally sized sheet but without any surface sizing) obtained (in roll form) in a thickness of about 100 μm and applying by coating extrusion to one side a ternary blend of poly(ethylene oxide)-b-poly (dimethyl siloxane)-b-polyethylene oxide, 2 percent by weight poly(diallyldimethyl ammonium chloride), 1 percent by weight hydroxypropylmethyl cellulose, 2 percent by weight, which blend was present in a concentration of 4 percent by weight in water. Thereafter the coating can be oven dried at 100°C and the paper can be utilized in a 4020™ color ink jet printer to obtain images with optical density values of 1.65 (black), 1.12 (magenta), 0.92 (cyan), 0.75 (yellow) with edge raggedness values of 0.20 (between black and yellow), 0.30 (between cyan and yellow), 0.10 (between magenta and yellow), and 0.45 (between magenta and cyan). Other

percentage of its original reflectance.

The porosity values recited herein were measured with a Parker Print-Surf porosimeter which records the volume of air/unit time flowing through a sheet of paper. The edge raggedness values recited in the present application were measured using an Olympus microscope equipped with a camera capable of enlarging the recorded ink jet images. The edge raggedness value is the distance in millimeters for the inter-color bleed on a checkerboard pattern.

The optical density measurements and the print through values recited herein were obtained on a Pacific Spectrograph Color System. The system consists of two major components, an optical sensor and a data terminal. The optical sensor employs a 6 inch integrating sphere to provide diffuse illumination and 8 degrees viewing. This sensor can be used to measure both transmission and reflectance samples. When reflectance samples are measured, a specular component may be included. A high resolution, full dispersion, grating monochromator was used to scan the spectrum from 380 to 720 nanometers (nm). The data terminal features a [illegible] CRT display, numerical keyboard for selection of operating parameters, and the entry of tristimulus values; and an alphanumeric keyboard for entry of product standard information. The print through value as characterized by the printing industry is log base 10 (reflectance of a single sheet of unprinted paper against a black background/reflectance of the back side of a black printed area against a black background) measured at a wavelength of 560 nanometers.

The following examples are being supplied to further define specific embodiments of the present invention, it being noted that these examples are intended to illustrate and not limit the scope of the present invention. Parts and percentages are by weight unless otherwise indicated.

EXAMPLE I

There were prepared 30 (216 X 279 mm) sheets, [illegible] μm in thickness, (Set A) of a laboratory, size paper with a Hercules internal sizing value of [illegible] seconds, a porosity of [illegible] ml/minute on the Dynamic Fiber [illegible] paper machine (manufactured by [illegible] France), using a [illegible] basis weight, and pulp composed of 10 percent by weight of dry bleached hardwood kraft and [illegible] percent by weight of a [illegible] dry bleached softwood kraft beaten in the refiner [illegible] to [illegible] minutes. [illegible] was added to a stainless steel storage tank and the percent solids was adjusted to [illegible] percent with deionized water. The pH of the mixture was adjusted to [illegible]. During the paper making process, the following operating conditions were used: drum speed - [illegible] meters/minute, jet speed - [illegible] meters/minute, jet to wire ratio - 1.0, stock flow - 1.5 liters/minute, stock pressure - 2.7 bars, number of passes - 100, sheet basis weight - 75.0 g/square meter, forming wire screen type - 72 x 58 mesh plastic wire screen from Johnson Wire Company, nozzle type - Model 2550-25, and nozzle to forming - wire distance, spacing 2.5 centimeters.

The Dynamic Former was loaded with the selected forming wire screen and the main drive motor was turned on. When the forming wire reached the required speed, water was added to the Former drum to allow the water wall to become level with the retaining bars. The 400 gram pulp fiber slurry was then pumped from the holding tank to the spray nozzle, and the spray nozzle drive was started to evenly spray the furnish on the rotating wire screen. When sufficient furnish had been sprayed to form a sheet of paper, the nozzle drive motor and the pump motor were deactivated while the main drive continued to run. The excess water was then slowly removed by movement of a scoop which caused the water wall to drain, leaving a thin pad of pulp fiber furnish evenly distributed on the plastic wire screen. The main drive motor was then deactivated and the endless belt of fiber was carefully cut and lifted out of the Former drum while the belt was still on the plastic wire screen. The wet paper sheet (at approximately 20 percent solid) was then placed on a wool felt blanket and the plastic wire screen was removed. A sheet of 7.5 μm thick Teflon was placed on top of the wet paper sheet and the sandwich pad was then pressed through the Dynamic Former press section to increase the solid content to 45 percent level. This was accomplished by passing the sandwich pad between the press rolls once at a nip pressure of 4.0 bar and twice at a nip pressure of 6.0 bar. The sheet of paper along with the Teflon backing sheet was lifted off the felt wool blanket and placed on the drying drum with Teflon in contact with the dryer surface. The dryer felt was then lowered over the paper sheet and was secured in position to restrain the sheet and prevent shrinkage during the drying process at 105°C.

These laboratory paper sheets (Set A) with 0.4 second internal sizing, and no surface sizing, were fed individually into a Xerox Corporation 4020™ color ink jet printer having incorporated therein four separate developer inks comprised of water, 90 percent by weight, ethylene glycol, 5 percent by weight, and a magenta, cyan, yellow and black colorants, respectively, 5 percent by weight, and there were obtained images with average optical densities of 1.05 (black), 1.05 (magenta), 0.85 (cyan) and 0.81 (yellow) with average intercolor bleed (edge raggedness) values of 0.25 millimeters (between black and yellow), 0.35 millimeter (between cyan and yellow), 0.15 millimeter (between magenta and yellow) and 0.25 millimeter (between magenta and cyan). The print through value of the black color was calculated at 0.[illegible]

A 100 μm thick Xerox 4024 base paper was [illegible]

surface sizing and an internal Hercules sizing value of 98 seconds printed under similar conditions with a Xerox 4020™ printer had a show through value of black (0.050) for the optical density of images 1.07 (black), 1.06 (magenta), 0.95 (cyan) and 0.90 (yellow). The intercolor bleed values, however, were higher at 2.0 millimeters (between black and yellow), 0.38 millimeter (between cyan and yellow), 0.40 millimeter (between magenta and yellow), and 0.35 millimeter (between magenta and cyan). This Xerox 4024™ [illegible] paper was then treated on a Keegan coater with a 2 percent aqueous solution of a [illegible] copolymer (35 milligrams (mg) per sheet), 0.5 percent by weight of [illegible] [illegible] poly(ethylene oxide) [illegible] block copolymer (PS 0750) and dried in the dryer oven at 100°C. The Hercules internal sizing value of 98 seconds (before treatment) decreased to 0.4 second (after treatment), indicating that the paper was treated. The resulting 116.5 µm thick paper was then fed into a Xerox 4020™ color ink jet printer and images were obtained with optical density values of 1.0 (black), 0.97 (magenta), 0.88 (cyan) and 0.70 (yellow). The drying time for images printed on the aforementioned treated papers was less than 1 second as evidenced by the absence of ink offsetting or image smearing on the platen pinch roll. The print through value for black color was calculated at 0.156, an increase from 0.050, but lower than 0.251 as was the situation for the lab prepared [illegible] papers with 0.4 second internal sizing and no surface sizing. The intercolor bleed values for the above prepared treated papers of the present invention were 0.30 (between black and yellow), 0.28 (between cyan and yellow), 0.12 (between magenta and yellow) and 0.08 (between magenta and cyan) which are similar to those obtained with untreated laboratory prepared 20 pound [illegible] with 0.4 second internal sizing, but no surface sizing. When replacing PS 0750 with a mixture of PS 073 (2.0 percent by weight), [illegible] [illegible] (1.0 percent by weight), hydroxypropylmethyl cellulose (2.0 percent by weight) in water as the treating solution on the coater, the print through values decreased to 0.106 without affecting the optical density and image ruggedness of images.

EXAMPLE 9

There were prepared 30 sheets each (216 X 279 mm) of 10 sets of plain papers with surface pH ranging from 5.5 to 7.5 containing different levels of internal sizing (which was also available from Monsanto) but with no surface sizing on the Dynamic Former using blends of [illegible] and [illegible] bleached hardwood kraft, 75 percent by weight, and [illegible] bleached softwood kraft, 25 percent by weight, in combination with titanium dioxide, fillers clay, alum and internal sizing. Papers were prepared from the following formulation by the process described in Example 1: [Set-A] 200 grams of pulp blend, 8 grams of titanium dioxide (Hercules sizing value 0.4 second, porosity 230 milliliters); [Set-B] 200 grams of pulp blend, 8 grams of titanium dioxide, 1 gram of sizing, 1 gram of alum and 0.1 gram of retention aid (Hercules sizing value of 70 seconds, porosity 280 milliliters); [Set-C] 200 grams of pulp blend, 8 grams of titanium dioxide, 2 grams of sizing, 2 grams of alum and 0.1 gram of retention aid (Hercules sizing value 255 seconds, porosity 275 milliliters); [Set-D] 200 grams of pulp blend, 8 grams of titanium dioxide, 4 grams of sizing, 4 grams of alum and 0.2 gram of retention aid (Hercules sizing value 455 seconds, porosity 260 milliliters); [Set-E] 272 grams of pulp blend, 8 grams of titanium dioxide, 20 grams of clay (Hercules sizing value 0.4 second, porosity 270 milliliters); [Set-F] 272 grams of pulp blend, 8 grams of titanium dioxide, 20 grams of clay, 2 grams of sizing, 2 grams of alum and 0.2 gram of retention aid (Hercules sizing value 90 seconds, porosity 260 milliliters); [Set-G] 272 grams of pulp blend, 8 grams of titanium dioxide, 20 grams of clay, 4 grams of sizing, 4 grams of alum and 0.2 gram of retention aid (Hercules sizing value of 650 seconds, porosity 265 milliliters); [Set-H] 172 grams of pulp blend, 8 grams of titanium dioxide and 40 grams of clay (Hercules sizing value 0.4 second, porosity 190 milliliters); [Set-I] 232 grams of pulp blend, 8 grams of titanium dioxide, 60 grams of clay, 2 grams of sizing, 2 grams of alum, 0.2 gram of retention aid (Hercules sizing value 40 seconds, porosity 220 milliliters); and [Set-J] 232 grams of pulp blend, 8 grams of titanium dioxide, 60 grams of clay, 4 grams of sizing, 4 grams of alum, 0.2 gram of retention aid (Hercules sizing value 195 seconds, porosity 220 milliliters). Seven sets of these papers with no surface sizing but having internal sizing values of 20, [Set-C], 40, [Set-I]; 90, [Set-F]; 195, [Set-J]; 255, [Set-B]; 455, [Set-D]; 650, [Set-G], seconds were printed in a Xerox 4020™ color ink jet printer. The intercolor bleed values ranged between 1.0 to 3.0 (between black and yellow); 0.15 to 2.5 (between cyan and yellow); 0.3 to 1.8 (between magenta and yellow); and 0.7 to 2.7 (between magenta and cyan). These seven papers were treated in the lab by the treating coater with aqueous solutions (concentrations ranging between 0.25 gram/100 milliliters to 4.0 grams/100 milliliters, respectively) of the treating agent [illegible] ethylene oxide)-b-poly(propylene oxide)-b-poly(ethylene oxide) block copolymer Alkasil [illegible] [illegible], a copolymer, and then dried at 100°C. To achieve an internal sizing value for all seven sets of papers to a level of 0.4 second, the percent concentration of Alkasil [illegible] by weight of the paper was approximately 0.5, 1.0, 2.0, 3.0, 4.0, 5.0 and 6.0, the lowest being for sizing values of 20 seconds and the highest being for the sizing value of 650 seconds. The average optical density values of images with [illegible]

to Set-B papers which did not contain any clay were 1.06 (black), 1.05 (magenta), 1.03 (cyan) and 0.83 (yellow). The average optical density values for Set-D, Set-H papers (8 percent clay) and Set-J, Set-K (15 percent clay) were 1.06 (black), 1.0 (magenta) 0.98 (cyan), 0.78 (yellow) and 0.96 (black), 0.93 (magenta), 0.96 (cyan), and 0.73 (yellow), respectively. The values of optical densities for treated papers at Hercules sizing of 0.4 second are similar to those obtained with their respective untreated blank counterparts such as Set-B, Set-E, Set-I having Hercules internal sizing value of 0.4 second. However, the edge raggedness (intercolor bleed) values of all seven treated papers at Hercules sizing value of 0.4 seconds were reduced to 0.37 (between black and yellow), 0.40 (between cyan and yellow), 0.17 (between magenta and yellow), and 0.30 (between magenta and cyan). The print through values of images for untreated papers of Set-B and treated papers for Set-C, Set-D and Set-E containing no filler were calculated at 0.275, 0.205, 0.186 and 0.198, respectively. The print through values of images for untreated papers of Set-F and treated papers of Set-G and Set-H containing 8 percent clay were calculated at 0.270, 0.195 and 0.180. The print through values of images for untreated papers from Set-I and treated papers from Set-J and Set-K containing 15 percent by weight of filler clay were calculated at 0.265, 0.190 and 0.165, respectively. These results suggest that the treated papers acting as coatings as well as filler may help to improve print through. The porosity values of the various sets of treated papers increased only by about 20 percent suggesting that the aforementioned decreasing of pores is the predominant factor in improving the edge raggedness of ink jet images.

EXAMPLE III

There were prepared 20 sheets each (8.5 X 11 inch) of three sets of filled papers (surface pH 8.5) containing different levels of calcium silicate (CAS 427-97-8), but no internal sizing and no surface sizing, on the Dynamic Former using Alsace 'Former' machine, 75 percent by weight, and Le Pages dry bleached softwood kraft, 25 percent by weight. Papers were prepared from the following formulations by the procedures described in Example I. Set-L, 300 grams of pulp, 40 grams of calcium silicate (paper thickness 118 μm; porosity 325 ml/minute, Hercules internal sizing 0.5 second); Set-M, 300 grams of pulp, 80 grams of calcium silicate (paper thickness 127 μm; porosity 365 ml/minute, Hercules internal sizing 0.5 second); and Set-N, 300 grams of pulp, 120 grams of calcium silicate (paper thickness 142 μm, porosity 390 ml/minute, Hercules internal sizing 0.5 second). These three sets of papers were printed with Xerox 4020™ color ink jet printer and images were obtained. The edge raggedness values of all three sets were recorded at 0.41 (between black and yellow), 0.37 (between cyan and yellow), 0.12 (between magenta and yellow), and 0.36 (between magenta and cyan). The average optical density of all three sets, Set-L, Set-M, Set-N were measured at 0.98, 1.05, 0.99 (black), 0.98, 0.96, 0.91 (magenta), 0.96, 0.98, 0.95 (cyan), and 0.77, 0.74, 0.67 (yellow), respectively. The print through values for Set-L, Set-M and Set-N were recorded at 0.178, 0.150, 0.066, respectively. These three sets of papers were treated with Cardex A1-172 of the present invention by affecting a dip coating process using 1 percent aqueous solutions and dried at 100°C in an oven. These treated papers were then fed into a Xerox 4020™ color ink jet paper and images were obtained with the following characteristics: print through values for Set-L (paper thickness 122.7 μm, porosity 300 ml/minute), Set-M (paper thickness 129.6 μm, porosity 336 ml/minute), and Set-N (paper thickness 148.2 μm, porosity 360 ml/minute) were lowered to 0.136, 0.092 and 0.064, respectively; no change in the edge raggedness values; optical densities of images were measured at 1.11, 1.03, 1.05 (black); 1.07, 1.02, 0.97 (magenta); 1.06, 0.97, 1.03 (cyan), and 0.81, 0.77, 0.78 (yellow), a slight increase in most cases. These results indicate that the desizing agent improves print through as well as the optical density of the images. Furthermore, a comparison of the print through values for untreated lower cost clay filled papers from Set-F and Set-I (0.265 and 0.270) with higher cost calcium silicate filled papers of Set-L (0.178) indicates that the latter material was superior in improving print through in this instance.

EXAMPLE IV

Commercially available internally and surface sized Diazo papers 90 μm in thickness and with an average Hercules sizing value of 1,500 seconds were treated in the laboratory using a dip coating process with aqueous solutions and methanol solutions of the following commercial desizing agents and dried at 100°C in an oven. The Hercules sizing values for the treated papers were measured in seconds and are presented in parentheses following the identity of the material, for 1 percent by weight, 99 percent of water: aqueous solutions of Tetronic 908 (470.0), Tetronic 90R4 (418.0), Pluronic C1 (38), Alkaterge PHP 30-4 (260.5), Tetronic 150R1 (10), Pluronic P 77 (16), Iconol 1-96 (99.5), Alkasurf 201-S (14.5), Tetronic 904 (20), Tetronic 90R4 (26), PS 072 (10.0), PS 555 (16.5), Alkasurf CO-25B (5), Alkasurf LA-EP (5), Alkasurf 0-14 (4.5), Alkasurf OP-12 (4), Alkamuls EGE 25-2 (4), Alkasurf NEP73-70 (3), PS071 (4), PS555 (3), PS073 (3), Cirrasol AE-177 (2), Alkasurf LAEP 25 (1.5), and Alkasurf LAEP-45 (0.5); for 1 percent by weight methanol solution, poly(1,4-oxytetramethylene) glycol (29), Alkaquat DAET (40), Alkasurf CO-

30 (2), Alkamuls (0.8), Aerosol-22S (0), Alkasurf (0), Alkodine SO-36A (2.7), Alkasurf NP-1 (2.4), Pluronic 25R2 (5.8), Tetronic 901 (3), Alkamide 2000N (2.4), Alkasurf CO-9 (2), Alkasurf SA-2 (1.8), Alkasurf LAN-3 (1), tetrapropylene glycol diacetoxy-ester (1), Alkamide T-2, (1) polypropylene glycol (1), Ionenol T-2 (1), Alkamide CDE (2), Tetronic 1509 (3), Alkasurf NP-6 (1), Pluronic L101 (1), Alkamidox C-7 (1), Alkamide SDR (1), Alkamide STD (1), Alkasurf CA (0.8), Alkasurf SS-O-75 (0.5), Alkasurf LAN-1 (0.4), Alkamide DS-680 (0.6), and Alkamide SDO (0.8); for water alone no dissolving agent (1,000); and for methanol alone no dissolving agent (784.4).

EXAMPLE V

The following commercially available internally and surface sized papers with a wide range of Hercules sizing (measured in seconds) and porosity (measured in ml/minute) were selected for treatment with ACA desizing agent by repeating the procedure of Example IV. The desized ASA sized paper consisted of copy paper-1 (17 seconds, 446 ml/minute), copy paper-2 (182.7 seconds, 548 ml/minute), Sanyo-L (22.7 seconds, 853 ml/minute), and AKD sized copy paper-3 (40.7) seconds, 920 ml/minute); the alkaline sized Xerox papers (1,269 seconds, 376 ml/minute), Great Lakes offset paper (271.5 seconds, 420 ml/minute), lightweight Conservation paper (32.4 seconds, 430 ml/minute), Automated office papers (70.9 seconds, 1,080 ml/minute), Tidal Rapid bond paper (22.5 seconds, 70 ml/minute) copy papers from Nekoosa (151 seconds, 661 ml/minute), Champion (360 seconds, 540 ml/minute), Xerox 4024™ (no surface sizing) (98 seconds, 819 ml/minute), Wiggins Teape (37.2 seconds, 400 ml/minute), Mead (100 seconds, 380 ml/minute), Domtar (25 seconds, 380 ml/minute), Mead (37.7 seconds, 470 ml/minute), Vetulux (286.4 seconds, 340 ml/minute), ink jet papers, James River Ultra (700 seconds, 351 ml/minute), Hewlett Packard Paint-Jet (194 seconds, 368 ml/minute), and Jujo (207 seconds, 125 ml/minute) were treated with 1 percent aqueous solution of Tamol NT-172 by a dip coating process and dried at 100°C in an oven. The Hercules sizing and porosity values of the treated papers was recorded as follows: Xerox paper (1.0 seconds, 410 ml/minute), Great Lakes offset (1.5 seconds, 420 ml/minute), Conservation (0.8 second, 600 ml/minute), Nekoosa (0.8 second, 840 ml/minute), Champion (1.2 seconds, 650 ml/minute), Automated (0.7 second, 1,200 ml/minute), Tidal Rapid bond paper (0.5 second, 30 ml/minute), Xerox 4024™ (no surface sizing) (0.5 second, 865 ml/minute), Wiggins Teape (0.9 second, 450 ml/minute), Plymouth (0.8 second, 805 ml/minute), Domtar (0.5 second, 770 ml/minute), copy paper-1 (0.6 second, 530 ml/minute), copy paper-2 (0.5 second, 346 ml/minute), copy paper-3 (0.4 second, 800 ml/minute), Mead (0.5 second, 505 ml/minute), Vetulux (1.5 seconds, 285 ml/minute), Sanyo-L (0.4 second, 265 ml/minute), James River Ultra (0.7 seconds, 305 ml/minute), Hewlett Packard Paint-Jet (0.1 second, 507 ml/minute), and Jujo (1.5 seconds, 125 ml/minute). These results indicate that the desizing agents of the present invention can desize a variety of papers containing alkaline and acid sizing compositions and render them suitable for ink jet printing without causing excessive changes in their porosity values which can be of importance for certain printing applications such as liquid toner printing with solvent or oil based inks.

EXAMPLE VI

There were prepared by substantially repeating the procedure of Example V 100 (216 X 279 mm) sheets (8×11) of treated papers by affecting a simultaneous treatment of a Xerox 4024™ base paper (which had no surface sizing) with a mixture of cellulose ether (10 percent by weight), polyethylene oxide-b-poly-(dimethyl siloxane)-b-polystyrene oxide triblock copolymer PS 070 (2 percent by weight), poly(benzyl-triethyl quaternary (1 percent by weight), which mixture was present in a concentration of 8 percent by weight in water. These sheets were dried at 100°C on the drying drum of the Dynamic Former. Ten of these sheets were then fed into a Xerox 4020™ color ink jet printer and images were obtained. The average optical density of the images was 1.01 (black), 1.02 (magenta), 0.81 (cyan) and 0.90 (yellow). The average edge raggedness values of 100 copies were calculated as 0.25 (between black and yellow), 0.40 (between cyan and yellow), 0.18 (between magenta and yellow), and 0.50 (between magenta and cyan) with a print through value of 0.102. These 100 images could not be handwiped or lifted off with a 3M scotch tape 60 seconds subsequent to their preparation.

EXAMPLE VII

Ten sheets of treated papers from Set (1) obtained from Example VI were fed into a Xerox Corporation 1005™ color xerographic apparatus and images were obtained with average optical density values of 1.62 (black), 1.55 (magenta), 1.72 (cyan) and 0.90 (yellow). The print through value of black was calculated at 0.090. These images could not be handwiped or lifted off with a 3M scotch tape 60 seconds subsequent to their preparation.

EXAMPLE VIII

Ten sheets of treated papers from Set (2) obtained from Example VI were fed through a Xerox Corporation 5090™ imaging apparatus and printed images

with an average optical density of 1.3 (black) with a print through value of 0.085. These images could not be smudged or lifted off 30 seconds subsequent to their preparation.

EXAMPLE IX

Ten sheets of coated paper from Set-D obtained from Example VI were fed into a dot matrix printer available from Roland Inc. as Roland PR-1012. The average optical density of the resulting images was 1.15 (black) with a print through value of 0.100. These images could not be smudged or lifted off 30 seconds subsequent to their preparation.

EXAMPLE X

Ten sheets of treated paper from Set-D obtained from Example VI were fed into a Xerox Corporation Memorywriter® typewriter equipped with a single strike ribbon and images of optical density 1.1 (black) were obtained. These images could not be smudged or lifted off 30 seconds subsequent to their preparation.

EXAMPLE XI

There were prepared ten sheets of treated papers each in a thickness of 95 μm by affecting a dip coating of 84.5 μm thick internally and surface sized [illegible] papers (Hercules sizing value 32.5 seconds, porosity 291 mL/minute) in a solution of hydroxypropyl cellulose (1 percent by weight) and Alcarine-0 (2 percent by weight), which mixture was present in a concentration of 3 percent by weight in methanol. These sheets were then dried at 100°C in an oven. Five of these ten sheets were fed into a Xerox Corporation 4020® ink jet printer and images were obtained with average optical density values of 1.05 (black), 1.0 (magenta), 1.05 (cyan), and 0.70 (yellow). The edge raggedness values for these images were 0.40 (between black and yellow), 0.40 (between cyan and yellow), 0.25 (between magenta and yellow) and 0.35 (between magenta and cyan). The print through value for black was calculated to 0.10. In comparison, an untreated liquid [illegible] paper when fed into Xerox Corporation 4020® ink jet printer had images with slightly higher optical density values of 1.18 (black), 1.10 (magenta), 1.25 (cyan), and 0.80 (yellow) but the edge raggedness of these images was much higher at 2.5 (between black and yellow), 2.0 (between cyan and yellow), 1.9 (between magenta and yellow), and 1.4 (between magenta and cyan) with a print through value for black of 0.165. The five remaining sheets were fed into an [illegible] thermal transfer printer. The resulting images had average optical density values of 1.20 (black), 0.91 (magenta) and 1.10 (cyan). In comparison, an untreated [illegible] paper when printed with [illegible] shows images with slightly higher optical density values of 1.28 (black), 0.99 (magenta) and 1.27 (cyan).

EXAMPLE XII

There were prepared 20 sheets each (216 X 279 mm) of three sets (Set-P, Set-Q, Set-R) of filled papers with a surface pH of 7.0 containing identical levels of [illegible] calcium silicate, clay, talc, titanium dioxide but different degrees of internal sizing (alkyl ketene dimer available from Hercules Company) and no surface sizing at the Dynamic Former using [illegible] dry bleached hardwood kraft, 70 percent by weight, and La Tuque dry bleached softwood kraft, 30 percent by weight. Papers were prepared from the following furnishes using the procedure described in Example I: Set-P, Set-Q, and Set-R all contain 250 grams of pulp, 50 grams of calcium silicate, 40 grams of clay, 20 grams of titanium dioxide, 20 grams of [illegible], and 0.5 gram of retention aid, but differ in the amount of sizing in each case, for example, Set-P contains 12 grams of sizing (Hercules internal sizing 200 seconds, paper thickness 118 μm, porosity 245 mL/minute), Set-Q contains 18 grams of sizing (Hercules internal sizing value of 488 seconds, paper thickness 127 μm, porosity 265 mL/minute), and Set-R contains 22 grams of sizing (Hercules internal sizing 757 seconds, paper thickness 124.5 μm, porosity 255 mL/minute). Five papers from each set were individually fed into a Xerox Corporation 4020® ink jet printer and images were obtained with an average optical density value of 1.1 (black), 1.0 (magenta), 0.96 (cyan), and 0.75 (yellow) with edge raggedness values of 0.45 (between black and yellow), 0.55 (between cyan and yellow), 0.35 (between magenta and yellow) and 0.45 (between magenta and cyan). Five papers from each set were treated with a 1 percent by weight solution of Alkaquat LA[illegible] and five other papers from each set were treated with a 50:50 blend of Alkaquat LA[illegible] and hydroxyethyl cellulose 250 LR, which blend was present in a concentration of 2 percent by weight in water. These papers were dried at 100°C in an oven. The Hercules internal sizing value of all treated papers was about 0.8 second. These papers were fed into a Xerox Corporation 4020® ink jet printer and images were obtained with edge raggedness values of 0.12 (between black and yellow), 0.20 (between cyan and yellow), 0.15 (between magenta and yellow) and 0.20 (between magenta and cyan). The average optical density values of the papers treated with Alkaquat LA[illegible] alone were 0.95 (black), 0.85 (magenta), 0.75 (cyan), and 0.65 (yellow). Papers treated with blends of Alkaquat LA[illegible] and hydroxyethyl cellulose 250 LR had optical density values of 1.05 (black), 0.95 (magenta), 1.00 (cyan) and 0.75 (yellow). The print through values of treated papers from both blends

Hercules internal sizing value [illegible] seconds), Set-Q (initial Hercules internal sizing value 480 seconds), and Set-R (initial Hercules sizing value 750 seconds) were [illegible] at 0.213, [illegible], and 0.065 for treatment with Alkosurf LAEP15 alone and at 0.[illegible], [illegible], and [illegible] for treatment with a blend of Alkosurf LAEP15 and [illegible] cellulose [illegible]. These results suggest that the initial high sizing composition [illegible] through even though the fibers [illegible] after treatment. The porosity values after treatment of these sets of papers with Alkosurf LAEP 15 alone increased by about 20 to 30 percent, but remained unchanged when treated with blends of Alkosurf LAEP15 and [illegible] cellulose [illegible].

EXAMPLE XIII

There were prepared 40 sheets (216 X 279 mm) each of two sets (Set-S, Set-T) of filled papers with surface pH of [illegible] containing identical levels of [illegible], calcium silicate, titanium dioxide, but different degrees of internal sizing (alkaline sizing Hercon-76 available from Hercules Chemical Company) and no surface sizing on the Dynamic Former using blends of Rosnyl 50 dry bleached hardwood kraft, 70 percent by weight, and a Thunder Bay bleached softwood kraft, 30 percent by weight. Papers were prepared from the following furnishes using the procedure described in Example 1. Set-S and Set-T both contain 200 grams of pulp, 100 grams of calcium silicate, 20 grams of titanium dioxide, 0.5 gram of retention aid but differ in the amount of sizing in each instance, that Set-S contains [illegible] grams of sizing (Hercules internal sizing value of 2,888 seconds, paper thickness of 130 μm, porosity of 440 milliliters), and Set-T contains 20 grams of sizing (Hercules internal sizing value of 4,688 seconds, paper thickness of 130 μm, porosity of 378 milliliters). Two papers from each set were individually fed into a Xerox Corporation 4024™ ink jet printer and images were obtained with an average value of 0.75 (black), 0.70 (magenta), 0.80 (cyan), and 0.80 (yellow) with edge raggedness values of 0.40 (between black and yellow), 0.55 (between cyan and yellow), 0.70 (between magenta and yellow), and 0.75 (between magenta and cyan). Two papers from each set were treated with the following coating agents of the invention and the Hercules sizing values for treated papers were measured in seconds and are presented in brackets following the identity of the coating agent. Treatments with 5 percent by weight solutions in methanol and: (1) poly(propylene glycol), Alkapol PPG-4000 (5.0 seconds); (2) tetra functional block copolymers of propylene oxide and ethylene oxide, Tetronic 150 R1 (1.2 seconds) and Pluronic L-101 (1.3 seconds); (3) sorbitan monolaurate, Alkamuls SML (5.0 seconds); (4) glycerol monooleate, Alkamuls GMO-45LG (3.5 seconds); (5) poly(ethylene glycol dioleate), Alkamuls 600 DO (2.5 seconds); (6) phosphate ester, [illegible] (1.5 seconds); (7) sodium dioctyl sulfosuccinate, Alkasurf SS-O75 (3.5 seconds); (8) sodium dodecyl benzene sulfonate, Alkasurf DA (0.5 seconds); (9) [illegible] acetate, Alkamide [illegible] (0.7 seconds); (10) amine ethoxylates, Alkaminox T-2 (5.5 seconds); (11) [illegible], Alkamidox [illegible] (2.5 seconds); (12) linear alcohol ethoxylate, Alkasurf LA-3 (7.8 seconds); nonyl phenol ethoxylate, Alkasurf NP-[illegible] (7.8 seconds); ethoxylates of sorbitan monostearate, Alkamuls PSML-4 (7.5 seconds); (13) [illegible] oleate, Alkamuls [illegible] (7.5 seconds); (14) castor oil ethoxylates, Alkasurf CO-[illegible] (4.5 seconds); and with 5 percent by weight solutions in water of (15) linear alcohol alkoxylate, Alkasurf LAEP-25; (16) poly(dimethyl siloxane)-b-poly(methylsiloxane alkylene oxide), Alkasil HEP 182-280 (1.5 seconds); (17) [illegible] functional polyol methyl siloxanes, PS-558 (2.0 seconds); (18) linear alcohol ethoxylate, Alkasurf LAEP-15 (1.5 seconds); (19) linear alcohol alkoxylate, Alkasurf LAEP-55 (1.5 seconds); and (20) quaternary ammonium [illegible], Gemtex [illegible] (2.0 seconds). These coatings had deposited on them approximately 300 milligrams of the coating agent (7.5 percent by weight of the paper). These papers were fed individually into a Xerox Corporation 4024™ color ink jet printer and images were obtained which dried in less than two seconds and had an average optical density value of 0.78 (black), 0.77 (magenta), 0.80 (cyan), and 0.80 (yellow) for the methanol soluble coating agents and 0.87 (black), 0.80 (magenta), 0.85 (cyan), and 0.80 (yellow) for the water soluble coating agents. The edge raggedness values of all coating agents were in the vicinity of 0.12 (between black and yellow), 0.25 (between cyan and yellow), 0.40 (between magenta and yellow), and 0.40 (between magenta and cyan). The print through values of Set-S treated samples with initial Hercules sizing value of 2,888 seconds were slightly higher at 0.088 compared to Set-T (4,688 seconds) treated samples with print through values of 0.069. These results indicate that the coating agents of the present invention render fibers and yield fast drying images with improved edge raggedness. Treated papers with high initial sizing yield less print through than those with lower initial sizing in this environment.

EXAMPLE XIV

There were prepared 4 treated papers at a thickness of 124.3 μm and porosity 298 milliliters from Set-R of Example XII by effecting a dip coating of these sheets into a coating solution of Alkasurf-[illegible], which coating was present in a concentration of 2 percent by weight in methanol. Subsequent to drying at 100° C. and monitoring the weight gain of the substrate, the coating, these sheets had present about 100 milligrams (50 milligrams on each side, 2.5

percent by weight of the paper) 8.5 μm in thickness, of Aloe Vera-G (each side). These papers were calendered in a 2 Roll Lab Calender Stack (Proctor Corp.) sent to a velocity of 100 filaments and a thickness of 90 μm. Two of these papers were fed into an Oki-mate 20 (Oki Company) thermal transfer printer. The resulting images had optical density values of 1.45 (black), 1.17 (magenta) and 1.5 (cyan) with a print through value of 0.075. Two other papers were fed into a Xerox 4020™ color ink jet printer and there were obtained images with optical density values of 0.98 (black), 0.97 (magenta), 0.88 (cyan), and 0.78 (yellow) with a print through value of 0.156. The edge raggedness of these images were recorded at 0.19 (between black and yellow), 0.28 (between cyan and yellow), 0.16 (between magenta and yellow) and 0.40 (between magenta and cyan).

The above results indicate that these and fiber papers when treated with the desizing materials and calendered to low porosities are useful for ink jet, and thermal transfer printing, and the like, where low porosity papers are selected.

EXAMPLE XV

There were prepared five treated papers in a thickness of 124.5 μm, porosity 250 ml/minute from Bock of Gowanda NY by affecting a dip coating of these sheets into a coating blend of Cerlox AT-172, 50 percent by weight, hydroxyethyl cellulose 250 LR, 40 percent by weight, quaternary compound, Mirapol 0.20 percent by weight, and colloidal silica (Syloid 244 a 1.5 LT), 10 percent by weight, which blend was present in a concentration of 5 percent by weight in water. Subsequent to oven drying at 100°C and recrushing the wedge pile to and subsequent to cooling, these sheets had present on each side 2.5 grams per meter square of the coating mixture, 2 μm thick on each side of the sheet. The Hercules sizing value for this coated paper was measured to be 1.2 seconds and porosity value of 25 ml/minute. These sheets were then fed individually into a Xerox Corporation 4020™ color ink jet printer and images were obtained with optical density values of 1.45 (black), 1.30 (magenta), 1.26 (cyan) 0.85, and (yellow) with edge raggedness values of 0.10 (between black and yellow), 0.30 (between cyan and yellow), 0.15 (between magenta and yellow), and 0.40 (between magenta and cyan), and print through value of 0.050. The print through value for commercially available Jujo office coated paper of 98.5 μm thickness, Hercules sizing value of 207 seconds, porosity 132 ml/minute, with optical density values of 1.40 (black), 1.38 (magenta), 1.37 (cyan), and 0.78 (yellow) when printed with a Xerox Corporation 4020™ ink jet printer was 0.075.

Other modifications of the present invention will occur to those skilled in the art subsequent to a review of the present application. These modifications, including equivalents thereof, are intended to be included within the scope of the present invention.

Claims

1. A paper comprising a supporting substrate treated with, or having thereon a coating of, one or more desizing agents selected from (1) hydrophilic poly(dialkylsiloxanes); (2) poly(alkylene glycol); (3) poly(propylene oxide) - poly(ethylene oxide) copolymers; (4) fatty ester modified compounds of phosphates, sorbitan, glycerol, poly(ethylene glycol), sulfosuccinic acid, sulfonic acid, alkyl amine; (5) poly(oxyalkylene) modified compounds of sorbitan esters, fatty amines, alkanol amides, castor oil, fatty acid, fatty alcohol; (6) quaternary alkosulfate compounds; (7) fatty imidazolines.

2. A paper in accordance with claim 1 wherein the desizing agent is admixed with, or dispersed in, a water soluble polymer.

3. A paper in accordance with claim 1 wherein the desizing agent is dispersed in or admixed with a hydrophilic film forming binder polymer.

4. A paper comprising a supporting substrate with a coating including a desizing agent and a hydrophilic polymer.

5. A paper in accordance with claim 4 wherein the hydrophilic polymer is a cellulose film forming binder component.

6. A paper in accordance with any one of claims 1 to 5 wherein the desizing agent is dispersed in or admixed with a film forming binder with a filler component.

7. A paper in accordance with claim 6 wherein the filler component includes one or more of clay, calcium silicate, calcium carbonate, hydrated silicas, and cellulosic materials.

8. A paper in accordance with claim 6 or claim 7 wherein the filler component includes a pigment.

9. A paper in accordance with claim 8 wherein the pigment component includes one or more of colloidal silicas, titanium dioxide, and barium sulfate.

10. A paper in accordance with any one of claims 1 to 5 wherein the coating includes starch.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP [illegible]

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.)
X	PATENT ABSTRACTS OF JAPAN vol. [illegible] no. [illegible] [illegible] December [illegible] & JP-A-[illegible] [illegible] * the whole document * -----	[illegible]	[illegible] [illegible] [illegible]
Y	[illegible] * page 2, lines [illegible] - [illegible]; claims 1-11 * -----	[illegible]	
			TECHNICAL FIELDS SEARCHED (Int. Cl.)
			[illegible] [illegible]

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
[illegible]	[illegible]	[illegible]

CATEGORY OF CITED DOCUMENTS

- X : particularly relevant if taken alone
- Y : particularly relevant if combined with another document of the same category
- A : technological background
- O : non-written disclosure
- P : intermediate document
- T : theory or principle underlying the invention
- E : earlier patent document, but published on, or after the filing date
- D : document cited in the application
- L : document cited for other reasons
- & : member of the same patent family, corresponding document